ANNALS OF CARNEGIE MUSEUM
VOL. 59, NUMBER 2, PP. 77–103 8 JUNE 1990

LATE DEVONIAN AND EARLY CARBONIFEROUS BRACHIOPODS (BRACHIOPODA, ARTICULATA) FROM THE PRICE FORMATION OF WEST VIRGINIA AND ADJACENT AREAS OF PENNSYLVANIA AND MARYLAND

JOHN L. CARTER
Curator, Section of Invertebrate Paleontology

THOMAS W. KAMMER[1]
Research Associate, Section of Invertebrate Paleontology

ABSTRACT

The Price Formation of West Virginia bears three distinct brachiopod faunas. The oldest two, of very late Devonian (late Famennian) age, are almost entirely limited to outcrops north of the West Virginia Dome. The presence of *Syringothyris angulata* Simpson, 1890, in the uppermost Devonian fauna suggests that this horizon should be correlated with some part of the Knapp-Corry sequence in northwestern Pennsylvania. The youngest more widespread fauna is of very early Carboniferous (early Kinderhookian) age and is similar to the fauna of the Riddlesburg Shale of southcentral Pennsylvania. New species proposed include *Schuchertella macensis* n. sp., *Schuchertella bowdenensis* n. sp., *Spinocarinifera marlintonensis* n. sp., *Macropotamorhynchus durbinensis* n. sp. and *Verkhotomia nascens* n. sp.

INTRODUCTION

Detailed study of brachiopod faunas from the Price Formation provides the first documented age determination for this formation in West Virginia. The Price, or Pocono Formation of older literature (see Kammer and Bjerstedt, 1986, for history of nomenclature), has traditionally been regarded as entirely Mississippian in age with its base marking the base of the Mississippian (Darton, 1894; Stose and Swartz, 1912; White, 1934; Weller *et al.*, 1948). Dally (1956) in an unpublished dissertation (reported in Arkle *et al.*, 1979) concluded that the faunas of the Pocono were time transgressive, being Kinderhookian in southern West Virginia and Osagean-Meramecian in northern West Virginia. Restudy of Dally's stratigraphic sections and specimens failed to support his conclusions. In fact the opposite is true. The Price is indeed time transgressive, but it is from northern to southern West Virginia, and has late Famennian faunas best developed in the north and Kinderhookian faunas best developed in the south. Kammer and Bjerstedt (1986) reported an Osagean fauna in the upper Price in extreme southern West Virginia similar to the Burlington-age fauna reported in Virginia by Butts (1940). This Osagean fauna is beyond the scope of this paper and is not considered further here.

The brachiopod identifications presented in this study supercede those listed in Kammer and Bjerstedt (1986) and Bjerstedt (1987). Of particular note is the misidentification of *Schuchertella bowdenensis* n. sp. and *Schuchertella macensis* n. sp. as *Schellwienella inflata* (White and Whitefield). This led to the interpre-

[1] Department of Geology and Geography, West Virginia University, Morgantown, WV 26506.
Submitted 14 August 1989.

tation that the Cussewago Sandstone at Bowden, Hendricks, and Rowlesburg was Kinderhookian rather than Famennian in age (Kammer and Bjerstedt, 1986, fig. 3).

The brachiopods of the Price Formation generally occur as lag deposits in high-energy sandstones. Associated fauna includes bivalves, gastropods, cephalopods, crinoid stems, and bryozoans. Most specimens are preserved as molds, although original shell material was collected at Clover Lick (SL 525), Mace (SL 527), Hendricks (SL 530), and Caldwell (SL 523). Each brachiopod locality is described in detail in the Appendix. Stratigraphic and geographic locations of the faunas are shown in Fig. 1 and 2.

STRATIGRAPHY

The Price Formation in West Virginia is comprised of distinctive lithologies that make the Price a readily mappable unit. The brown to gray sandstones, siltstones, and shales of the Price are easily distinguished from the underlying and overlying lithologies. Over most of the state the Price is underlain by the red beds of the Hampshire Formation. Where the Price is underlain by the Chemung, or Greenland Gap Formation (Dennison, 1970), in the southernmost counties, the base of the Price can be recognized by the presence of the Cloyd Conglomerate Member, or the Sunbury Shale Member where the Cloyd is missing. The red beds of the Maccrady Formation overlie the Price in southern West Virginia, whereas the Greenbrier Limestone overlies the Price in central and northern West Virginia. In the eastern panhandle of West Virginia the red beds of the Mauch Chunk overlie the Rockwell Formation and Purslane Sandstone (=Burgoon Sandstone of Pennsylvania), which are lateral lithostratigraphic equivalents of the Price.

Deposition of Price sediments occurred in two large depocenters separated by a syndepositionally positive tectonic feature referred to as the West Virginia Dome (Kammer and Bjerstedt, 1986; Bjerstedt and Kammer, 1987). At the center of the dome the Price is completely absent, with the Greenbrier Limestone directly overlying the Hampshire Formation (Fig. 1). The Price north of the dome is older and has more nonmarine facies. South of the dome the Price is younger and dominantly marine, representing the entire facies spectrum of a prograding sedimentary wedge, from basinal to upper delta plain.

The Price Formation in northern West Virginia is divided, in ascending order, into the Oswayo, Cussewago Sandstone, Riddlesburg Shale, and Rockwell members (Kammer and Bjerstedt, 1986). These members are recognized as separate formations in Pennsylvania (Fig. 1) and clearly represent discrete genetic events (Bjerstedt and Kammer, 1988). The Oswayo was deposited during a late Famennian transgression of the Catskill delta red beds of the Hampshire Formation. The Cussewago Sandstone represents a late Famennian regression of deltaic sands. The Riddlesburg Shale formed during an early Kinderhookian transgression that extended all the way to Riddlesburg, Pennsylvania. It is dominantly shale, but interbedded sandstone is common, particularly at the base. The Sunbury Shale is a lateral equivalent of the Riddlesburg (Kammer and Bjerstedt, 1986). The Rockwell is a nonmarine wedge of sediments that prograded over the Riddlesburg.

In southern West Virginia the Price Formation is divided into three parts with the Cloyd Conglomerate Member and Sunbury Shale Member (or Riddlesburg Shale Member) near the base and an upper, unnamed part comprising the majority of the Price (Fig. 1). The Cloyd Conglomerate represents a late Famennian pro-

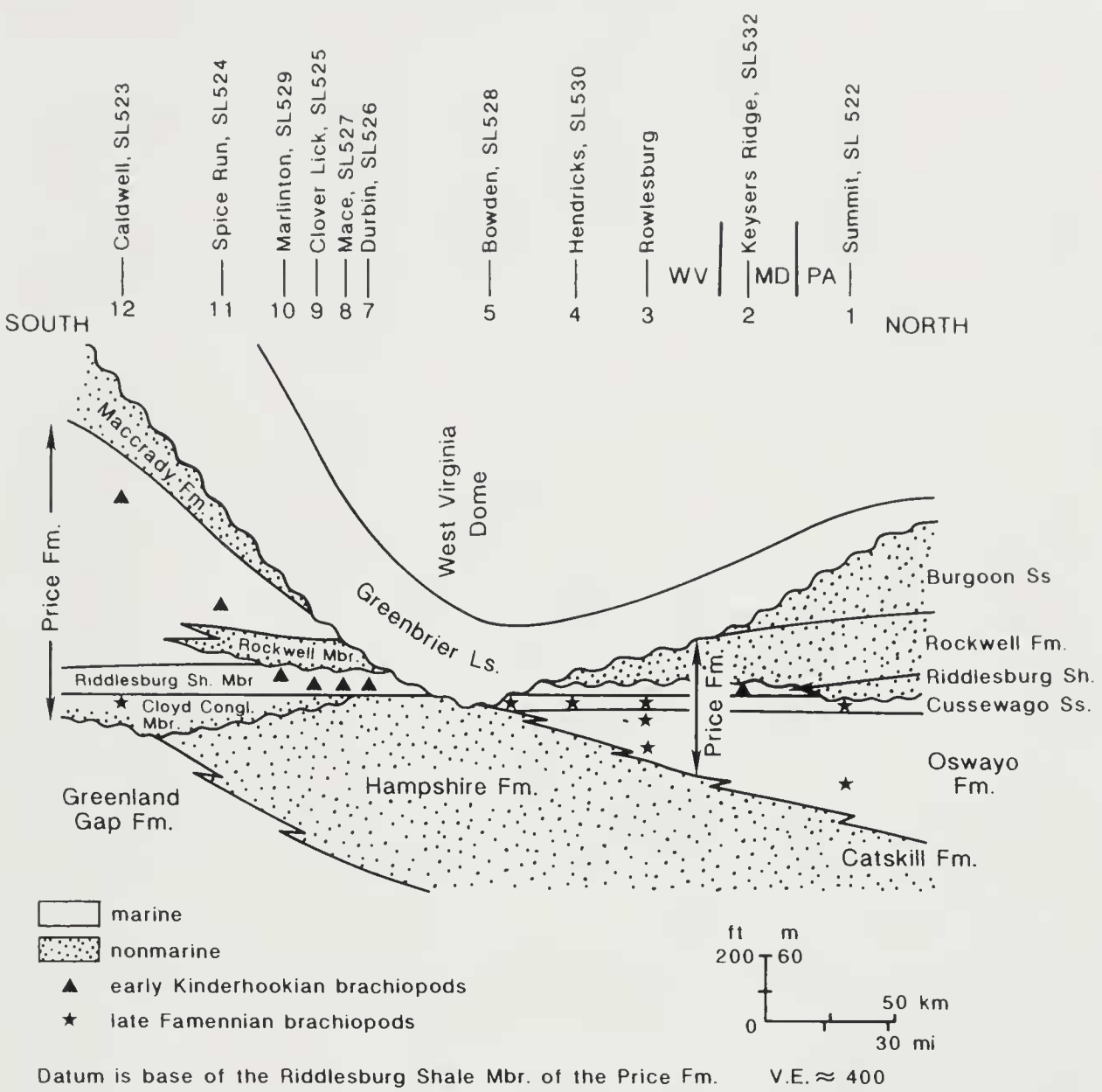


Fig. 1.—Lithostratigraphic cross section from Caldwell, West Virginia, to Summit, Pennsylvania.

gradation, but there are two minor transgressive deposits with brachiopods near the top (Bjerstedt, 1987, fig. 3). The black Sunbury Shale crops out at Bluefield, West Virginia. North of Bluefield the Sunbury grades into the Riddlesburg Shale, which is gray and contains interbedded sandstones. The upper part of the Price consists of sandstones, siltstones, and shales. Its heterolithic character does not permit ready subdivision into members. The rocks record a coarsening-upward marine deltaic sequence capped by fluvial sandstones (Bjerstedt and Kammer, 1988).

BIOSTRATIGRAPHY

Arkle *et al.* (1979) repeated Dally's (1956) unpublished conclusions that the Price Formation in southern West Virginia was Kinderhookian through Osagean in age, and that the Price in northern West Virginia was Osagean through Mer-

Fig. 2.—Index map showing collecting localites in the Price Formation of West Virginia. The numbers refer to stratigraphic locality collections in The Carnegie Museum of Natural History.

amecian in age. Restudy of Dally's collections, which are deposited at West Virginia University, indicates that most of his brachiopod identifications were incorrect, and thus his biostratigraphic conclusions are invalid.

Englund *et al.* (1988), in an abstract, reported the Osagean brachiopods *Orthotetes* cf. *O. keokuk* (Hall), *Brachythyris* cf. *subcardiiformis* (Hall) (=*Skelidorygma subcardiiformis* (Hall) of Carter, 1974), and *Syringothyris subcuspidata* (Hall) in the Price (Pocono) from the "crest" of the West Virginia Dome, presumably from Bowden or nearby environs. They concluded that the Price was time transgressive from south to north, being Kinderhookian in the south, and that the Hampshire Formation, therefore, must include beds of Mississippian age in northern West Virginia. Their conclusions are untenable based on the results of the present study. Their reported *Orthotetes keokuk* may be *Schuchertella bowdenensis* n. sp. and their *Syringothyris subcuspidata* may be *Syringothyris angulata* Simpson of this report. There does not appear to be a corresponding homeomorph of their *Skelidorygma subcardiiformis* in the Price.

The general areal distribution and pertinent collecting localities of the brachiopods reported here are shown in Fig. 2 and the stratigraphic distribution of the collections from these localities is given in Table 1. In northeastern West Virginia

Table 1.—*Stratigraphic distribution of brachiopods, and the nautiloid* Neocycloceras obliquum, *at various localities and horizons in the Price Formation (Fig. 1 and 2, Appendix).*

	Localities*														
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Famennian															
Rhipidomella sp.	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–
Schuchertella bowdenensis n. sp.	–	–	–	X	X	X	–	–	–	–	–	–	–	–	–
"*Chonetes*" sp.	–	–	–	–	X	–	–	–	–	–	–	–	–	–	–
Centrorhynchus? sp.	–	–	–	–	–	X	–	–	–	–	–	–	–	–	–
Centrorhynchus alleganius (Williams)	X	X	–	–	–	–	–	–	–	–	–	–	–	–	–
Cyrtospirifer sp. A	–	–	X	–	–	–	–	–	–	–	–	–	–	–	–
Cyrtospirifer sp. B	–	–	–	X	X	X	–	–	–	–	–	–	–	–	–
Cyrtospirifer sp.	X	X	–	–	–	–	–	X	–	–	–	–	–	–	–
Syringothyris angulata Simpson	–	–	–	X	X	X	X	–	–	–	–	–	–	–	–
Neocycloceras obliquum Flower and Caster	–	–	–	–	–	X	X	–	–	–	–	–	–	–	–
Kinderhookian															
Rhipidomella huntingdonensis (Girty)	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–
Schuchertella macensis n. sp.	–	–	–	–	–	–	–	–	X	X	X	X	–	–	–
Subglobosochonetes acutiliratus (Girty)	–	–	–	–	–	–	–	–	–	–	X	X	X	X	X
Spinocarinifera marlintonensis n. sp.	–	–	–	–	–	–	–	–	–	–	–	–	X	X	–
Macropotamorhynchus durbinensis n. sp.	–	–	–	–	–	–	–	–	–	X	X	X	X	–	–
Syringothyris sp.	–	–	–	–	–	–	–	–	–	–	–	X	–	–	–
Verkhotomia nascens n. sp.	–	–	–	–	–	–	–	–	X	–	X	X	–	–	–

* Localities (see Appendix)

A. Summit, lower Oswayo Formation.
B. Rowlesburg, lower Oswayo Member.
C. Summit, SL 522, Cussewago Sandstone.
D. Rowlesburg, upper Oswayo Member and Cussewago Sandstone Member.
E. Hendricks, SL 530, Cussewago Sandstone Member.
F. Bowden, SL 528, Cussewago Sandstone Member.
G. Wamsley Run, Cussewago Sandstone Member.
H. Caldwell, Cloyd Conglomerate Member.
I. Keysers Ridge, SL 532, sandstone in Riddlesburg Shale Member.
J. Durbin, SL 526, Riddlesburg Shale Member.
K. Mace, SL 527, basal sandstone of Riddlesburg Shale Member.
L. Clover Lick, SL 525, sandstone of Riddlesburg Shale Member.
M. Marlinton, SL 529, Riddlesburg Shale Member.
N. Spice Run, SL 524, upper part of Price Formation.
O. Caldwell, SL 523, upper part of Price Formation.

there are three brachiopod-bearing marine units (Fig. 1). The lowest two of these are of late Famennian age. The lowest fauna is dominated by numerous unidentifiable cyrtospiriferids and the large rhynchonellid *Centrorhynchus alleganius* (Williams, 1887), neither of which are illustrated or described here. The middle brachiopod fauna is dominated by two large distinctive species, *Syringothyris angulata* Simpson, 1890, and *Schuchertella bowdenensis* n. sp. A small rhipidomellid and a small chonetid are rare, unidentifiable, and of little biostratigraphic value. A large strongly ribbed rhynchonellid, identified here as *Centrorhynchus?* n. sp., is clearly of Devonian affinities and is probably closely related to *Centrorhynchus alleganius* (Williams). The latter is restricted in stratigraphic distribution to the Oswayo Formation of Pennsylvania, also of late Famennian age, but underlies and is older than the latest Devonian Knapp and Corry units of northwestern Pennsylvania. Lastly, there is a rare, small species of the genus *Cyrtospirifer* Nalivkin.

According to Sass (1960), *Syringothyris angulata* Simpson occurs in both the Knapp Formation and Corry Sandstone of northwestern Pennsylvania. The presence of *Syringothyris angulata* Simpson in the Price is taken here to indicate correlation between the lower Price and some portion of the Knapp-Corry sequence in northwestern Pennsylvania.

Berg *et al.* (1983, 1985) have placed the Knapp-Corry sequence in the Lower Mississippian. However, according to Caster (1930, 1934), Greiner (1957), and Sass (1960), both the Knapp and Corry contain several species of the characteristic Upper Devonian genus *Cyrtospirifer* Nalivkin. The senior author can find no confirmable record of this genus occurring in accurately dated Carboniferous beds, either in the literature or from other sources. In fact, McKellar (1970:10) stated that this genus does not even range up to the highest part of the Famennian, the Zone d'Etroeungt, in Eurasia and Australia. In North America *Cyrtosprifer* does not occur in the latest Famennian strata of two well-documented sections, the Louisiana Limestone of the midcontinent (Williams, 1943) and the age equivalent beds of the Sappington Formation of Montana (Rodriguez and Gutschick, 1967). We take the presence of *Cyrtospirifer* in the Knapp-Corry sequence in northwestern Pennsylvania and in the lower Price Formation of West Virginia to indicate a Devonian age for these beds.

The younger fossiliferous marine zone in the Price Formation of West Virginia, the Riddlesburg Shale Member and the upper Price in southern West Virginia, contains a brachiopod fauna with two species that were first described from the Riddlesburg Shale of southcentral Pennsylvania (Fig. 1). These are *Rhipidomella huntingdonensis* Girty, 1928, and *Subglobosochonetes acutiliratus* (Girty, 1928). In addition, *Schuchertella macensis* n. sp. and *Macropotamorhynchus durbinensis* n. sp. bear some similarity to species illustrated by Girty (1928) from the Riddlesburg. Therefore, we correlate this younger marine zone in the Price with the Riddlesburg Shale. We assign a Mississippian age to this fauna due to the presence of *Verkhotomia nascens* n. sp. and *Spinocarinifera marlintonensis* n. sp., as well as the correlation with the Riddlesburg. The genus *Verkhotomia* Sokolskaya, was based on a Viséan species in the Soviet Union but has extensive distribution in the late Kinderhookian and Osagean of North America. The genus *Spinocarinifera* Roberts, 1971, appears very near the Devonian-Carboniferous boundary in Europe as *Spinocarinifera niger* (Gosselet). In North America, prior to this report, the genus is known from the middle and late Kinderhookian. Finally, this upper marine zone contains no characteristically Devonian elements.

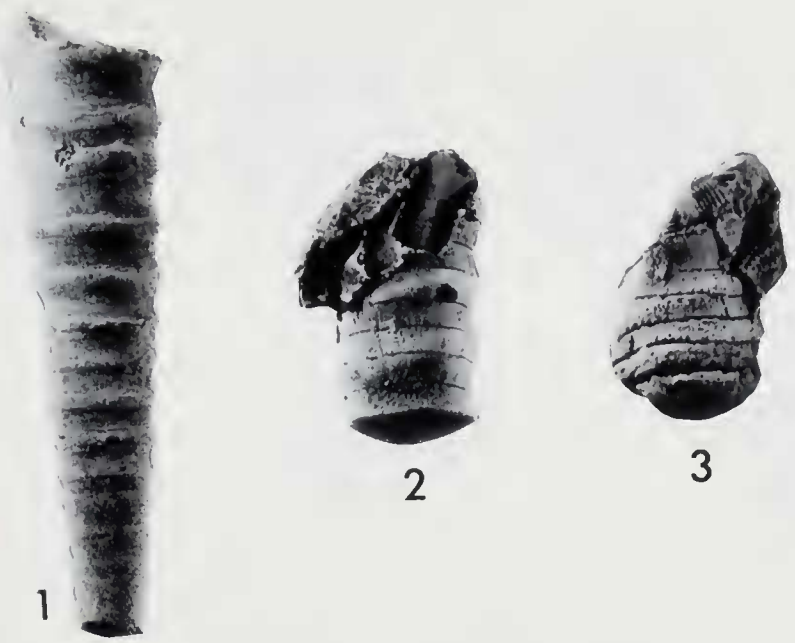


Fig. 3.—*Neocycloceras obliquum* Flower and Caster; 3.1, latex cast of orthocone exterior, CM 34806, note the distinct annulations, from Wamsley Run; 3.2, natural cast of orthocone interior, CM 34807, note that the annulations cross the sutures at an oblique angle, from Wamsley Run; 3.3, natural cast of orthocone interior, CM 34808, from Bowden (SL 528); both 3.2 and 3.3 have non-cephalopod shell debris at their adoral ends; all ×1.

The occurrence of the distinctive nautiloid *Neocycloceras obliquum* Flower and Caster at Bowden and Wamsley Run provides additional evidence of a late Famennian age for the associated brachiopods. *Neocycloceras obliquum* was described from the Amity Shale Member of the Venango Formation of northwestern Pennsylvania (Flower and Caster, 1935). The Price specimens of this unusual species are illustrated here in Fig. 3.

SYSTEMATIC PALEONTOLOGY

The specimens upon which this paper is based are all deposited in The Carnegie Museum of Natural History, Section of Invertebrate Paleontology. The suprageneric classification used here follows that of Cooper and Grant (1972–77) or the Treatise on Invertebrate Paleontology.

Phylum Brachiopoda Duméril
Class Articulata Huxley
Order Enteletacea Waagen
Superfamily Rhipidomellacea Alichova
Family Rhipidomellidae Schuchert
Genus *Rhipidomella* Oehlert, 1890

Rhipidomella sp.
Fig. 4.1–4.2

Remarks.—Several poorly preserved disarticulated valves of a small indeterminate species of this genus occur in the Late Famennian beds of the Price Formation at Bowden, locality SL 528. The pedicle valve illustrated as Fig. 4.1 is smaller than the other specimens from this locality, the brachial valve, Fig. 4.2, being most similar in size to the few remaining specimens.

Fig. 4.—Punctate orthids; 4.1, 4.2, *Rhipidomella* sp., 4.1, a small natural mold of a pedicle valve interior, CM 34809; 4.2, a medium-sized brachial valve exterior, CM 34810; both from locality SL 528, and both ×2; 4.3–4.7, *Rhipidomella huntingdonensis* Girty, 1928; 4.3, a spalled pedicle valve exterior from locality SL 525, CM 34811; 4.4, a large spalled brachial valve exterior from locality SL 527, CM 34812; 4.5, latex cast of a pedicle valve interior from locality SL 525, CM 34813; 4.6, 4.7, latex casts of two brachial valve interiors from locality SL 525, CM 34814, 34815; all ×1.

Rhipidomella huntingdonensis Girty, 1928
Fig. 4.3–4.7

1928. *Rhipidomella huntingdonensis* Girty, p. 115, 116, pl. 22, fig. 16–23.

Syntypes.—USNM 180642, 180645, 180691, 180693, 180694, 180706.

Remarks.—This species is a fairly common one at Clover Lick (SL 525) although good specimens are not easy to obtain. It is rarely found at Mace (SL 527) where Kammer and Bjerstedt (1986) identified it as *Rhipidomella pennsylvanica* (Simpson). Assignment of these specimens to *Rhipidomella huntingdonensis* Girty, 1928, is based on size, shell outline, and the ventral muscle scars. The ribbing on these Price specimens appears to be slightly coarser than that described by Girty (1928: 115), who recorded about three capillae per millimeter at the front margin. However, topotype specimens in our collections from the Riddlesburg Shale show about 2 to 2.5 capillae per millimeter, about the same as measured for the Price specimens.

Order Strophomenida Öpik
Suborder Orthotetidina Waagen
Superfamily Orthotetacea Waagen
Family Schuchertellidae Williams
Subfamily Schuchertellinae Williams
Genus *Schuchertella* Girty, 1904

Schuchertella macensis, new species
Fig. 5.1–5.8

Holotype.—A large spalled pedicle valve, CM 34816, Fig. 5.1, from Mace (SL 527).

Paratypes.—Natural mold of a medium pedicle valve interior, CM 34820, Fig. 5.7, 5.8, from Clover Lick (SL 525). Two small brachial valves, CM 34817 and 34818, Fig. 5.2–5.5, from localities SL 525 and 527, respectively. Natural mold of a brachial valve interior, CM 34819, Fig. 5.6, from Clover Lick (SL 525).

Description.—Large for genus, moderately convexo-concave or convexo-planar, outline transversely subquadrate to subelliptical; greatest width usually attained near midlength; body cavity moderately thick; ornament finely and evenly costellate, new costellae added by intercalation on both valves; strong growth varices irregularly spaced on either valve; shell substance densely and finely pseudopunctate.

Pedicle valve thin, usually slightly concave or more rarely slightly convex or almost flat; lateral extremities rounded in large adults, subangular in juveniles; beak small with no indication of cementation; ventral umbo moderately produced and projecting moderately posterior to hingeline in many specimens; interarea low, flattened, acutely triangular, apsacline to catacline; pseudodeltidium strongly convex, about as wide as high; teeth strong and thick, dental plates lacking; muscle field weakly impressed.

Brachial valve thicker than pedicle valve, moderately to strongly inflated, most convex in umbonal region, evenly convex over remainder of valve except for posterolateral concave flexures forming slightly rounded lateral extremities; dorsal interarea, if present, not observed; chilidium not observed; cardinal process low, bilobed, supported medially by strong socket plates; adductor field weakly impressed.

Distinguishing characters.—This species is characterized by its large size, slightly concave to weakly convex pedicle valve, transverse outline, rounded lateral extremities, moderately posteriorly protuberant ventral umbo, and evenly and moderately convex brachial valve.

Comparisons.—In the Price Formation *Schuchertella macensis* n. sp. is similar to *Schuchertella bowdenensis* n. sp. in size and convexity but differs in having a more consistently transverse outline and a slightly more posteriorly protuberant ventral umbo. In addition, the pedicle valve of *bowdenensis* is consistently resupinate or flattened and rarely, if ever, convex. The pedicle valve of *macensis* is more variable in profile, from resupinate to moderately convex.

Schuchertella hardinensis Carter, 1988, from the Glen Park Formation of Illinois and Missouri, is about the same age as *Schuchertella macensis* n. sp. but differs in being much smaller, more transverse, with the pedicle valve being usually weakly convex and having different ornament.

Jesse Hyde (1953:226) assigned several large orthotetids to the species *Schellwienella inflata* (White and Whitfield). Hyde's specimens lack dental plates and probably belong in *Schuchertella.* This Logan Formation species, although much younger than *Schuchertella macensis* n. sp., is similar to the latter in size, outline, and profile. It differs in being very asymmetrical, having a concave ventral interarea, and the pedicle valve is not concave as in *Schuchertella macensis* n. sp.

Remarks.—Girty (1928:116) assigned several poorly preserved and much distorted specimens of a medium-sized orthotetid to the widely used species *Schuchertella chemungensis* (Conrad, 1842). The latter species, of Chemung age, is assigned to the impunctate genus *Floweria* Cooper and Dutro (1982) by these authors. Girty's specimens may belong in the Price species but are too poorly preserved for reassignment here. Kammer and Bjerstedt (1986) identified *Schuchertella macensis* n. sp. as *Schellwienella inflata* (White and Whitfield).

Distribution.—This species is common at Clover Lick, Durbin, and Mace (SL 525, 526 and 527) in the Price Formation. It is common in a sandstone of the Riddlesburg Shale Member at Keyser's Ridge, Maryland (SL 532), but the specimens at that outcrop are smaller than those in West Virginia.

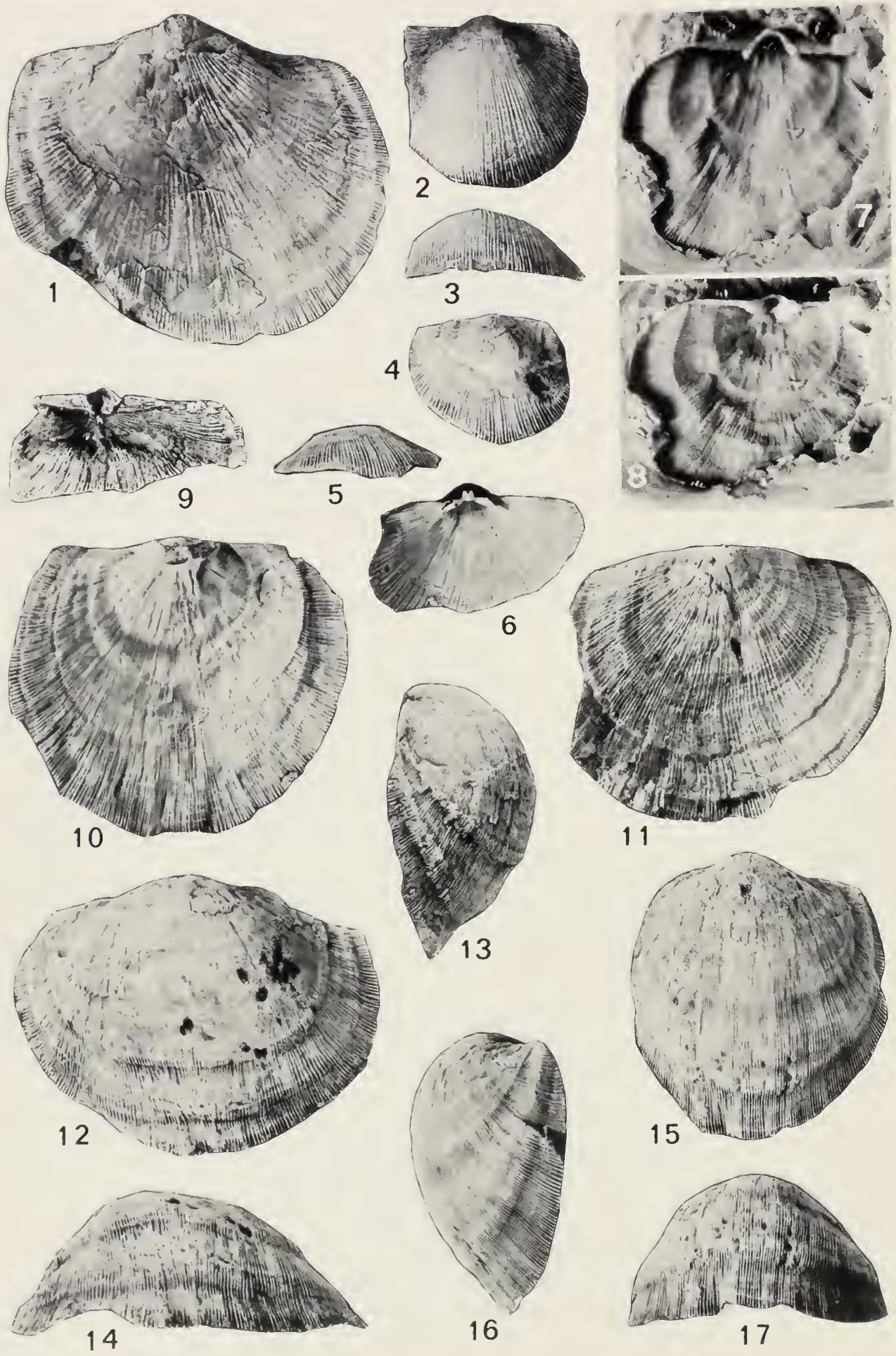

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17

Table 2.—*Measurements (in mm) of the types of* Schuchertella macensis *n. sp.*

CM#	Locality	Valve	Length	Width	Height
34816	SL 527	Pedicle	48.4	56.0	—
34820	SL 525	Pedicle	34.8	+36.6	±7.5
34817	SL 525	Brachial	25.3	+28.0	11.5
34818	SL 527	Brachial	19.0	23.9	7.1
34819	SL 525	Brachial	(too incomplete to measure)		

Schuchertella bowdenensis, new species
Fig. 5.9–5.17

Holotype.—A large pedicle valve, CM 34822, Fig. 5.10, from Bowden (SL 528).

Paratypes.—A large pedicle valve, CM 34823, Fig. 5.11; two large brachial valves, CM 34824 and 34825, Fig. 5.12–5.17; a pedicle valve interior, CM 34821, Fig. 5.9; all from Bowden (SL 528).

Description.—Large for genus, strongly and unequally convexo-concave, outline usually subovate or slightly elongate or transverse, rarely strongly transverse or elongated; greatest width attained near or posterior to midlength; body cavity deep with strongly inflated brachial valve and thin resupinate pedicle valve; ornament finely and evenly costellate, new costae on both valves added almost exclusively by intercalation; strong growth varices irregularly spaced in later growth stages; shell substance finely pseudopunctate.

Pedicle valve consistently thin, often resupinate; lateral extremities rounded in all observable growth stages; beak small, slightly rounded, not overhanging interarea, with no indication of cementation; umbonal region poorly produced, slightly convex; remainder of visceral region usually weakly concave or flattened; interarea low, flat or slightly convex, acutely triangular, catacline or very slightly apsacline; pseudodeltidium strongly convex, much higher than wide; teeth moderately strong; dental plates lacking; muscle field weakly impressed.

Brachial valve strongly inflated and much thicker than pedicle valve, most convex in umbonal region with flanks sloping steeply to margins; rounded lateral extremities delimited by slightly concave flexures; dorsal interarea, if present, not observed; chilidium not observed; cardinal process low and and bilobed; adductor field weakly impressed; other internal details not observed.

Distinguishing characters.—This species can be recognized by its large size, subovate outline, very strongly inflated brachial valve paired with an almost consistently resupinate pedicle valve, and generally narrow pseudodeltidium.

Comparisons.—See the above discussion of species comparisons under *Schuchertella macensis* n. sp.

Remarks.—Although the pedicle valves of *Schuchertella bowdenensis* n. sp. and *Schuchertella macensis* n. sp. are sometimes difficult to distinguish, the brachial valves readily allow differentiation of these closely related species. Small speci-

←

Fig. 5.—Orthotetids; 5.1–5.8, *Schuchertella macensis* n. sp.; 5.1, the holotype, a large spalled pedicle valve exterior from locality SL 527, CM 34816; 5.2–5.5, dorsal and anterior views of two small spalled brachial valve exteriors from localities SL 525 and 527, CM 34817 and 34818, respectively; 5.6, latex cast of a brachial valve interior from locality SL 525, CM 34819; 5.7, 5.8, ventral and oblique posterior views of a latex cast of a medium-sized pedicle valve from locality SL 525, CM 34820; all ×1; 5.9–5.17, *Schuchertella bowdenensis* n. sp.; 5.9, ventral oblique view of a pedicle valve interior showing the absence of dental plates, from locality SL 528, CM 34821; 5.10, natural mold of the exterior of the holotype, a large pedicle valve from locality SL 528, CM 34822; 5.11, natural mold of a pedicle valve exterior from locality SL 528, CM 34823; 5.12–5.17, dorsal, lateral, and anterior views of two brachial valve natural molds from locality SL 528, CM 34824 and 34825; all ×1.

Table 3.—*Measurements (in mm) of the types of* Schuchertella bowdenensis *n. sp.*

CM#	Locality	Valve	Length	Width	Height
34822	SL 528	Pedicle	+43.7	49.5	+6.6
34823	SL 528	Pedicle	+40.9	+47.1	+5.5
34824	SL 528	Brachial	+42.1	51.2	+21.1
34825	SL 528	Brachial	+42.8	+38.5	+18.7
34821	SL 528	Pedicle	(too incomplete to measure)		

mens of these species are difficult to identify. Kammer and Bjerstedt (1986) identified this species as *Schellwienella inflata* (White and Whitfield).

Distribution.—This species is common at Bowden and Hendricks (SL 528 and 530).

Suborder Chonetidina Muir-Wood
Superfamily Chonetacea Bronn
Family Anopliidae Muir-Wood
Subfamily Tornquistiinae Afanasjeva
Genus *Subglobosochonetes* Afanasjeva, 1976

Subglobosochonetes acutiliratus (Girty, 1928)
Fig. 6.1–6.7

1928. *Chonetes acutiliratus* Girty, p. 117, pl. 23, fig. 5–8.

Syntypes.—USNM 163248–163251, 180686–180689, from the Riddlesburg Shale, Great Trough Creek Gap, Terrace Mountain, four miles east of Marklesburg, Huntingdon County, Pennsylvania.

Remarks.—Although this species was based on deformed molds in shale, our identification here is made with fair confidence. The size, outline, and ornamentation of the Price specimens agree very closely with Girty's description of the Riddlesburg types. The ornament is particularly important in distinguishing chonetid species. In the Price specimens there are about 10 or 11 costellae per 3 mm and the costellae are subangular with rounded intercostellar furrows, a feature that is especially noticeable on the brachial valves. The number of spines at the hingeline is also comparable, with about eight or nine internal spine molds but with several fewer functional external spines. The Price specimens usually have four or five functional spines. Specimen size varies greatly in the Price specimens with small juveniles making up much of a chonetid coquina in the Price near Caldwell, West Virginia (SL 523). The largest of these specimens is nearly 14 mm in width. Most of the specimens illustrated here on Fig. 6 are less than 10 mm wide but were chosen for their preservation or internal details regardless of size. Kammer and Bjerstedt (1986) identified this species as *Tornquistia* sp.

Subglobosochonetes jerseyensis Carter, 1988, from the Glen Park Formation of the Mississippi Valley region, is similar in size and outline to *Subglobosochonetes acutiliratus* (Girty, 1928) but can be differentiated by its irregular ribbing, less inflated lateral profile, and fewer internal hinge spine perforations.

Distribution.—This species can be found in fair abundance at Mace, Clover Lick, and Marlinton (SL 527, 525 and 529). At Caldwell (SL 523) there is a bed composed mainly of this species in the upper part of the Price (see Appendix).

"*Chonetes*" sp.
Fig. 6.8, 6.9

Remarks.—Several specimens of a small transverse unidentifiable chonetid were recovered from Hendricks (SL 530) in the Famennian portion of the Price. These few specimens, the best of which are illustrated here, are all pedicle valves, rendering generic identification impossible. These specimens are about 6–7 mm wide, are moderately and evenly convex and have slightly rounded lateral extremities. There are six spine tubules on each side of the ventral beak along the ventral hingeline and the costellae increase by both bifurcation and intercalation. Except for their small size and transverse outline these small specimens are similar to small specimens of *Subglobosochonetes acutiliratus* (Girty).

Suborder Productidina Waagen
Superfamily Productacea Gray
Family Leioproductidae Muir-Wood and Cooper
Subfamily Leioproductinae Muir-Wood and Cooper
Genus *Spinocarinifera* Roberts, 1971

Spinocarinifera marlintonensis, new species
Fig. 6.10–6.18

Holotype.—A slightly crushed pedicle valve, CM 34835, Fig. 6.10, from Marlinton (SL 529).

Paratypes.—One large crushed pedicle valve, CM 34836, Fig. 6.11, and two natural molds of brachial valve exteriors, CM 34837 and 34838, Fig. 6.12, 6.13, from Marlinton (SL 529); three slightly distorted pedicle valves, CM 34839–34841, Fig. 6.14–6.18, from Spice Run (SL 524).

Description.—Medium size for genus, strongly concavo-convex, with thick body cavity; length and width subequal, often slightly wider than long; greatest width attained anterior to hingeline, usually near or slightly anterior to midlength; outline usually subovate or subellipsoidal, rarely subquadrate; lateral profile semicircular; auriculations small, subangular, compressed; trail short to medium in length; shell substance not observed.

Pedicle valve strongly inflated and most convex in umbonal region; weak to moderate sulcus originating in umbonal region, remaining shallow throughout; flanks sloping steeply to lateral margins, lateral profile curving evenly to anterior margin with no indication of geniculation; umbo broad, beak small, slightly overhanging hingeline; ornament of visceral disc consisting of weak rugae and weak to moderate irregular elongate spine ridges; trail ornament consisting of rounded slightly irregular costae, about 5–7 per 5 mm; spine bases distributed irregularly on crests of costae with several bases on auriculations; presence or absence of hinge spines not established; growth lines not detected; internal details not observed.

Brachial valve strongly geniculated, much thinner than pedicle valve; visceral disc weakly concave or flattened with lateral auriculations well defined by convex flexures; trail short and almost normal to visceral disc; ornament consisting of reticulate visceral disc and costate trail, similar to that of opposite valve; spine bases not observed but elongate dimples reflect spine bases of opposite valve present; weak fold present on anterior portion of visceral disc and trail; interior incompletely known; cardinal process not completely observed but probably bilobed, supported by thick base of short breviseptum; elongate alveolus probably present, at least in some specimens; lateral ridges extending along hingeline; adductor scars small, moderately raised, guttate in outline; other internal details not observed.

Distinguishing characters.—This species is characterized by its non-geniculate pedicle valve, strongly geniculate brachial valve, short trail, shallow sulcus and low fold, subovate outline, and 5–7 costellae per 5 mm on the trail.

Comparisons.—In North America there are no species of this genus of similar age and morphology to *Spinocarinifera marlintonensis* n. sp. In western Europe

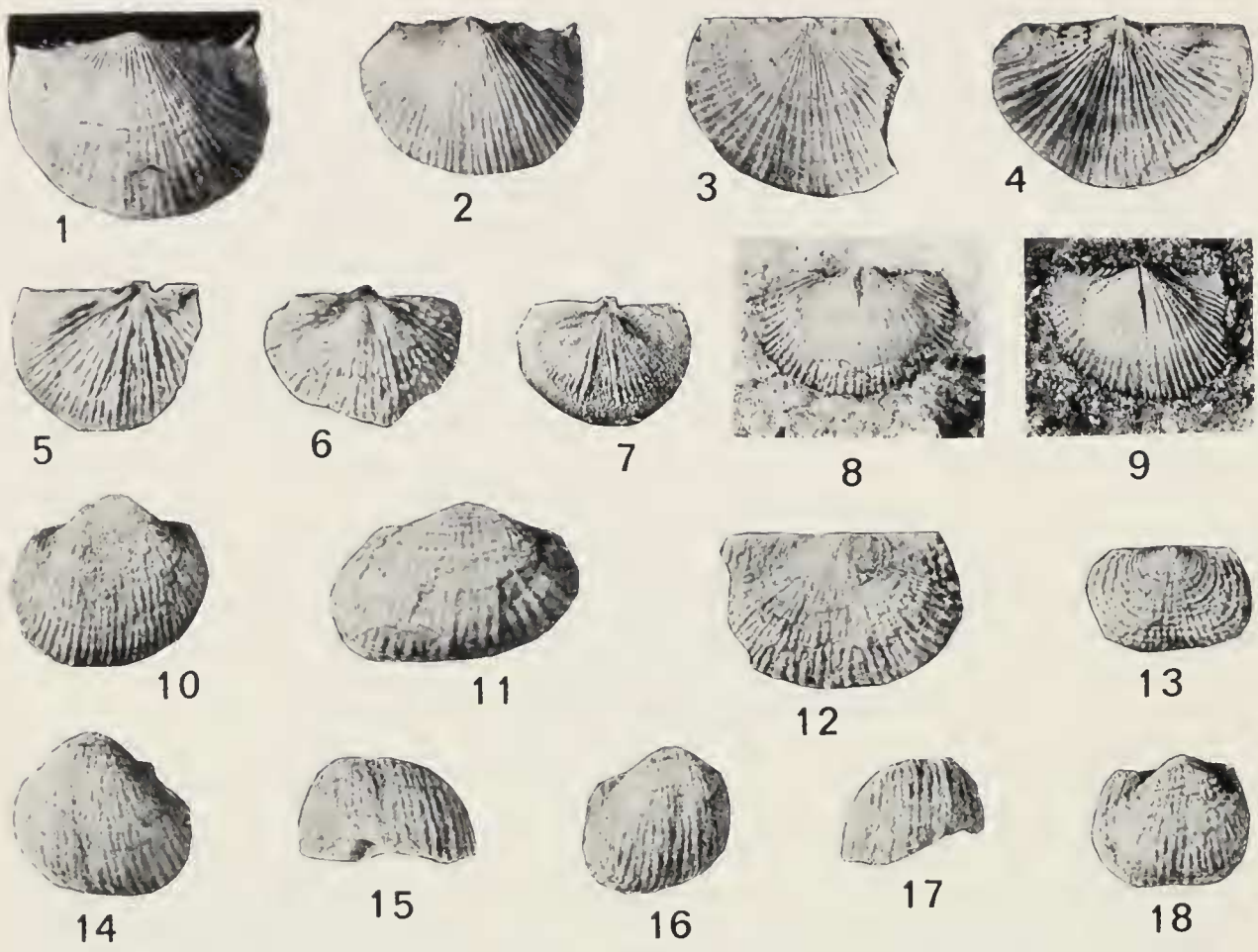


Fig. 6.—Chonetids and productids; 6.1–6.7, *Subglobosochonetes acutiliratus* (Girty, 1928); 6.1, a slightly spalled pedicle valve, CM 34826; 6.12, a small pedicle valve, CM 34827; 6.3, 6.4, two brachial valve exteriors, CM 34828 and 34829; 6.5, 6.6, two brachial valve interiors, CM 34830 and 34831; all from locality SL 527; all ×3; 6.7, a latex cast of a brachial valve interior, CM 34832, from locality SL 525, ×2; 6.8, 6.9, "*Chonetes*" sp., two natural molds of pedicle valves from locality SL 530, CM 34833 and 34834, ×3; 6.10–6.18, *Spinocarinifera marlintonensis* n. sp.; 6.10, natural external mold of the holotype, a pedicle valve from locality SL 529, CM 34835; 6.11, natural mold of a pedicle valve exterior from locality SL 529, CM 34836; 6.12, 6.13, natural molds of two brachial valve exteriors from locality SL 529, CM 34837 and 34838; 6.14–6.18, natural molds of three pedicle valves from locality SL 524, CM 34839–34841; all ×1.

Spinocarinifera niger (Gosselet, 1888), of about the same age, is similar in size and outline but is easily differentiated by its longer trail, lack of a consistently developed fold-sulcus, and coarser costellae. *Spinocarinifera adunata* Roberts, 1971, from the Lower Tournaisian of Australia, is similar in size, ornamentation, and profile to *Spinocarinifera marlintonensis* n. sp. but differs in lacking a fold-sulcus and has much better defined auriculations.

Remarks.—The poor preservation of all of the specimens of this species has resulted in a less than complete description. The illustrations in Fig. 6 could give a false impression of the dimensions and proportions of this species because all of them are distorted in one or more planes. For example, Fig. 6.11 and 6.12 are greatly flattened dorso-ventrally. In Fig. 6.11 the trail is pushed posteriorly under the visceral disc, and in Fig. 6.12 the trail is flattened outwards. Kammer and Bjerstedt (1986) listed this species as *Dictyoclostus mesicostalis* (Weller).

Distribution.—This species is found only at Marlinton and Spice Run (SL 529 and SL 524).

Table 4.—*Measurements (in mm) of the types of* Spinocarinifera marlintonensis *n. sp.*

CM#	Locality	Valve	Length	Width	Height
34835	SL 529	Pedicle	18.0	20.4	+7.6
34836	SL 529	Pedicle	+16.1	−25.6	11.1
34837	SL 529	Brachial	−17.1	±24.8	+4.7
34838	SL 529	Brachial	12.2	17.7	4.1
34839	SL 524	Pedicle	17.6	18.4	+9.0
34840	SL 524	Pedicle	15.9	14.5	9.3
34841	SL 524	Pedicle	14.2	16.5	+7.0

Order Rhynchonellida Kuhn
Superfamily Rhynchonellacea Gray
Family Trigonorhynchiidae McLaren
Genus *Centrorhynchus* Sartenaer, 1970

Centrorhynchus? sp.
Fig. 7.1–7.4

Remarks.—Two large pedicle valves of a strongly ribbed rhynchonellid were recovered at Bowden (SL 528). These specimens are associated with Famennian cyrtospiriferids and syringothyridids. Lacking interiors, generic assignment is uncertain, but externally this species is similar to species assigned by Sartenaer (1970) to his genus *Centrorhynchus*. *Rhynchonella alleghenia* Williams, 1887, from the Oswayo Shale of the Allegheny Plateau region, was tentatively assigned to *Centrorhynchus* by Sartenaer (1970). This species is similar to the Price specimens in being large with strong ribbing. It differs in having more numerous ribs and a more elongate outline. It is highly likely that these pedicle valves represent an undescribed species but more specimens, including interiors, are needed for description.

Genus *Macropotamorhynchus* Sartenaer, 1970

Macropotamorhynchus durbinensis, new species
Fig. 7.5–7.20, 8

Holotype.—Natural internal mold, CM 34844, Fig. 7.5–7.8, from Durbin (SL 526).

Paratypes.—Two internal molds, CM 34845 and 34846, Fig. 7.9–7.16, both from Durbin (SL 526); a small spalled but otherwise complete specimen, CM 34847, Fig. 7.17–7.20, from Mace (SL 527).

Description.—Medium size for genus, unequally biconvex, wider than long; outline transversely subtrigonal to subovate; greatest width attained slightly anterior to midlength; lateral profile subquadrate to subovate; anterior commissure uniplicate and serrate; fold and sulcus moderately well developed in larger specimens, poorly expressed in juveniles; posterolateral margins slightly compressed; anterolateral margins serrate; both valves with strong simple subangular plicae; sulcus with four to six, usually five, plicae, commonly including one or, more rarely, two parietal plicae; flanks with six to ten, usually seven or eight, plicae that become progressively weaker posterolaterally; shell substance impunctate; micro-ornament, if any, not observed.

Pedicle valve slightly to moderately convex posteriorly with broad poorly defined umbonal region and small, often poorly differentiated, moderately incurved beak; lateral slopes flattened or weakly convex anteriorly, slightly concave posteriorly; greatest convexity in umbonal region; foramen and

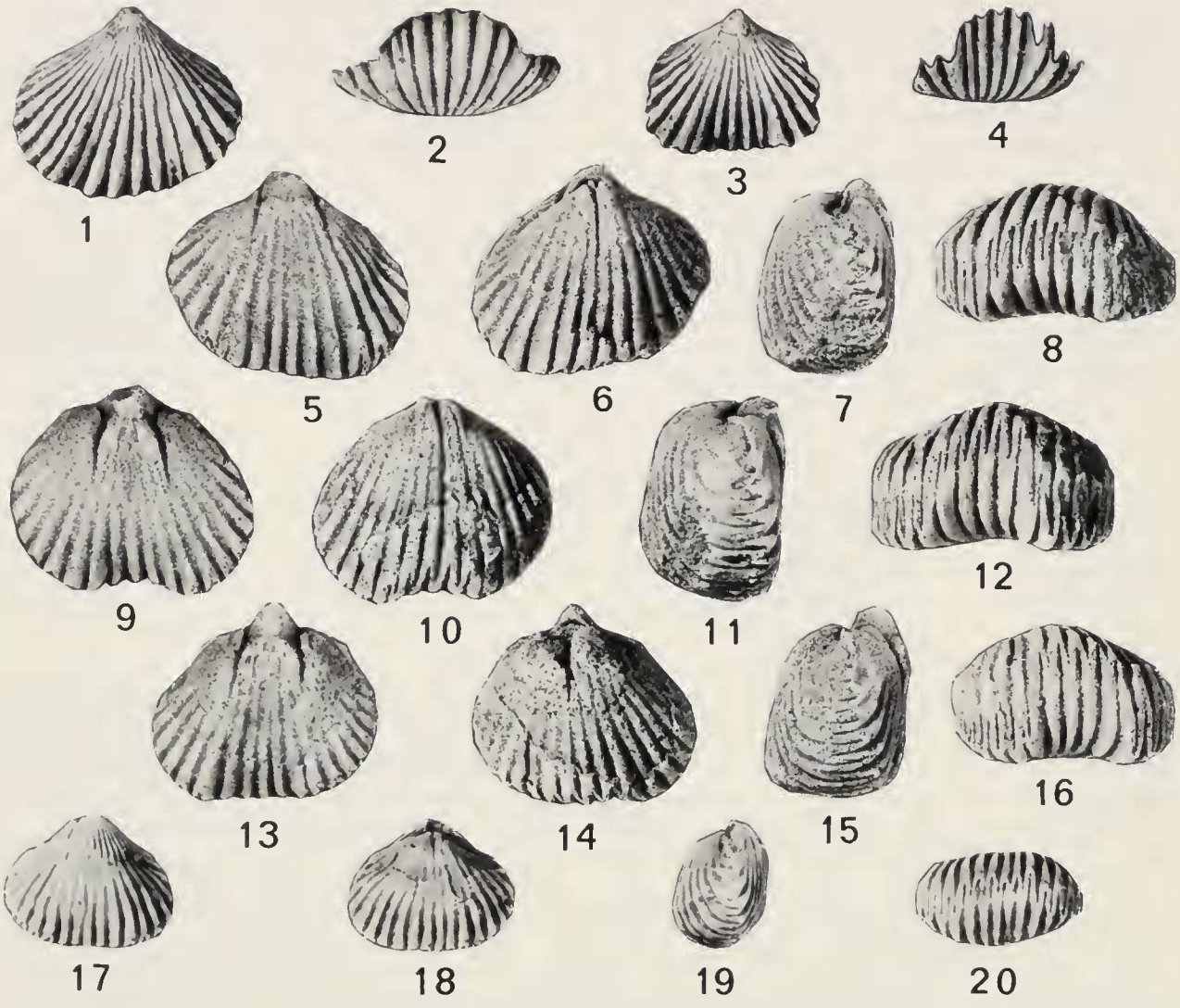


Fig. 7.—Rhynchonellids; 7.1–7.4, *Centrorhynchus?* n. sp., ventral and anterior views of two natural external molds of pedicle valves from locality SL 528, CM 34842 and 34843, ×1; 7.5–7.20, *Macropotamorhynchus durbinensis* n. sp.; 7.5–7.8, ventral, dorsal, lateral, and anterior views of the holotype, a natural internal mold from locality SL 526, CM 34844; 7.9–7.16, ventral, dorsal, lateral, and anterior views of two natural internal molds from locality SL 526, CM 34845 and 34846; 7.17–7.20, ventral, dorsal, lateral, and anterior views of a spalled but otherwise complete shell from locality SL 527, CM 34847; all ×2.

deltidium not observed; beak ridges subangular; sulcus originating just anterior to umbonal region, becoming moderately well developed anteriorly, often with rounded bottom, forming low rounded to flattened tongue in larger specimens; interior with short, stout, slightly diverging dental plates and deeply impressed ventral muscle field.

Brachial valve much more inflated than pedicle valve, most convex in umbonal region, weakly convex anterior to umbonal region, flanks sloping with moderate convexity to lateral margins; maximum depth attained anterior to midlength; cardinal margins slightly compressed; fold originating anterior to umbonal region, rising only slightly to moderately even in large specimens; interior with short covered septalium supported by low, thick median septum that extends forward to about midlength; connectivium moderately thick, slightly arched; crural bases fused to both inner and outer hinge plates; crura short, broadly flattened posteriorly, becoming trigonal or arcuate in section, then curving ventrally, diverging slightly; adductor field indistinct in section.

Distinguishing characters.—This species is characterized by its moderately large size, transverse trigonal to subovate outline, short broad umbonal region, and by having about five plicae in the sulcus and about seven or eight on the flanks.

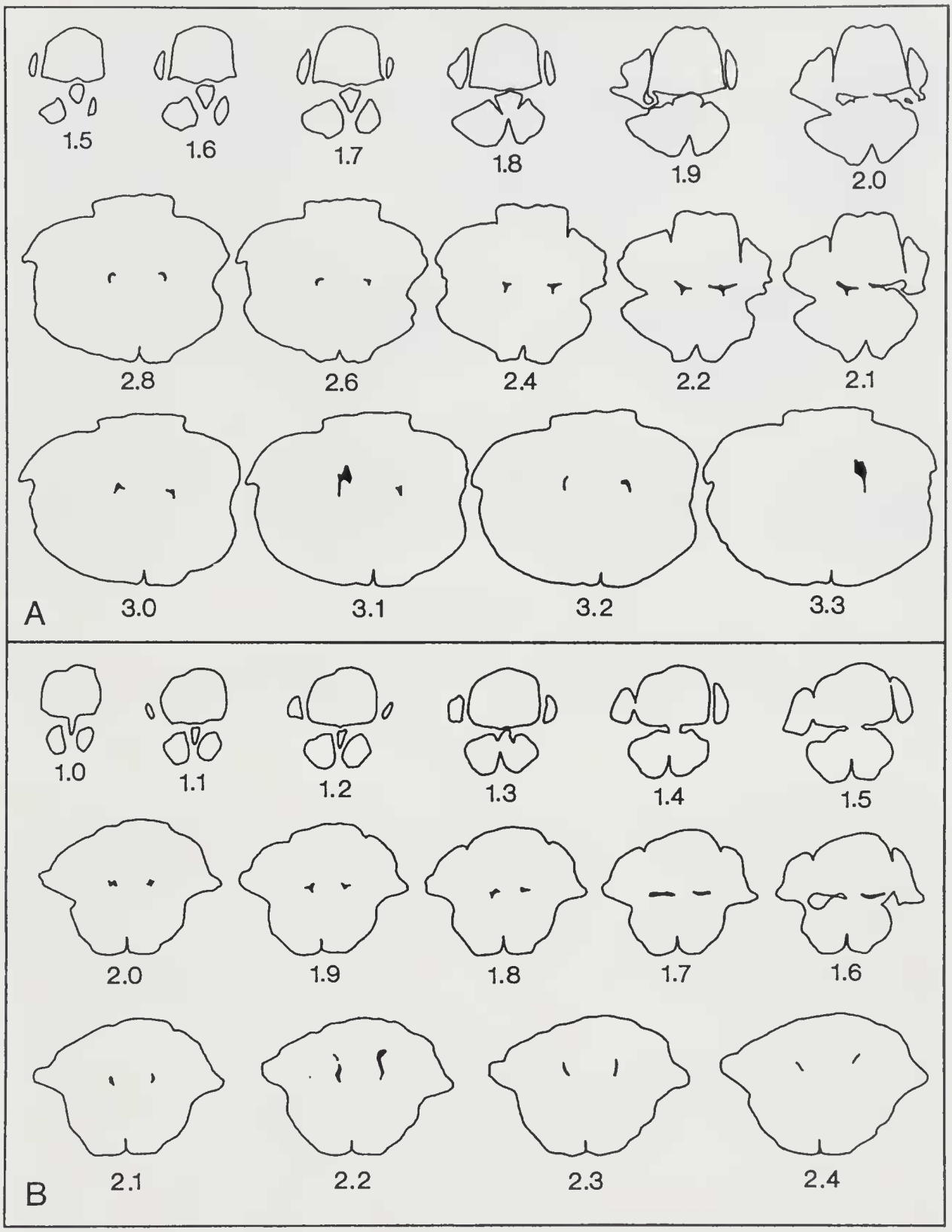


Fig. 8.—Transverse serial sections of natural molds of *Macropotamorhynchus durbinensis* n. sp., from locality SL 526, ×4. A, a large mature specimen with deeply incised ventral muscle field, CM 34848; B, a smaller specimen, CM 34849. Numbers refer to distance in mm from posteriormost part of internal mold.

Table 5.—*Measurements (in mm) of the types of* Macropotamorhynchus durbinensis *n. sp.*

CM#	Locality	Length	Width	Thickness	Ribs/sulcus	Ribs/flank
34844	SL 526	+11.2	+13.4	+7.7	5	7
34845	SL 526	+11.5	+13.2	+7.8	5	7
34846	SL 526	+11.4	+12.2	+7.5	5	7
34847	SL 527	7.3	9.0	5.1	5	8

Comparisons.—There are few impunctate rhynchonellids described from the earliest Mississippian in North America. The specimen attributed to *Camarotoechia tuta* (Miller) from the Bushberg Sandstone of Missouri reported by Branson (1938:166) and the specimens also assigned to this species from the Sappington Formation of Montana by Rodriguez and Gutschick (1967) are not very similar to *Macropotamorhynchus durbinensis* n. sp. *Camarotoechia kentuckiensis* Foerste, 1909, from the Bedford Shale of Kentucky may come from beds of approximately this age, although the age of the Bedford is still in dispute. It is not closely similar to the Price species in that it is smaller, more elongate and has fewer plicae.

Distribution.—This species is common at Clover Lick, Durbin, and Mace (SL 525, 526, and 527). It is rare at Marlinton (SL 529).

Order Spiriferida Waagen
Suborder Spiriferidina Waagen
Superfamily Spiriferacea King
Family Cyrtospiriferidae Termier & Termier
Genus *Cyrtospirifer* Nalivkin, 1924

Cyrtospirifer sp. A
Fig. 9.1–9.5

Remarks.—A small collection of cyrtospirifers, mostly disarticulated valves, was obtained from beds that Laird (1941) termed the Cussewago Sandstone on Chestnut Ridge in Fayette County, Pennsylvania (SL 522). These beds lie above the Oswayo Formation (or member) which contains the typical Oswayo *Centrorhynchus alleganius* fauna and underlie the nonmarine Rockwell Formation, and thus represent a portion of the lower Price Formation to the south. Although a definitive fauna is not present at this locality, it is clear that this species of *Cyrtospirifer* is distinct from that of the Famennian age fauna of the Price at Bowden (SL 528) and Hendricks (SL 530), West Virginia. The Chestnut Ridge species is much larger, distinctly alate, with a strongly developed fold-sulcus. Identification of this species is difficult. Preservation as sandstone external molds preserve little fine detail and leaves only gross external features for comparison with described species. Greiner (1957) described several species of this genus from beds of approximately this age in northwestern Pennsylvania, often distinguishing them on the basis of internal features and details of ornamentation. Because these characters are not determinable from the specimens at hand, a comparison with them is not made here.

Cyrtospirifer sp. B
Fig. 9.6–9.9

Remarks.—Another species of the genus *Cyrtospirifer* occurs in the late Famennian beds of the Price Formation in West Virginia at Bowden and Hendricks (SL 528 and 530). This species is much smaller than the one from Chestnut Ridge

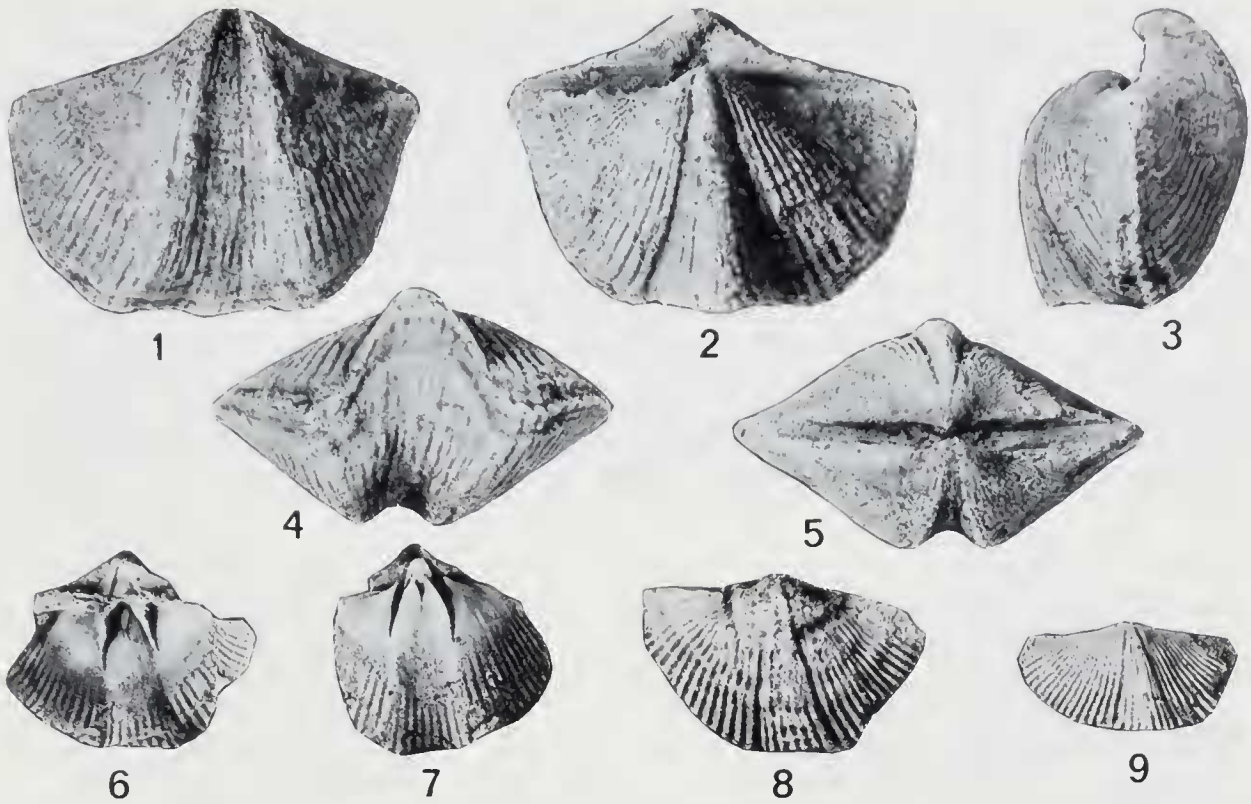


Fig. 9.—Cyrtospiriferids; 9.1–9.5, ventral, dorsal, lateral, anterior, and posterior views of a natural external mold of *Cyrtospirifer* sp. A from locality SL 522, CM 34850, ×1; 9.6–9.9, *Cyrtospirifer* sp. B; 9.6, 9.7, a latex cast and the natural internal mold of the pedicle valve from locality SL 528, CM 34851; 9.8, a large pedicle valve external mold from locality SL 528, CM 34852; 9.9, a small natural external mold of a pedicle valve from locality SL 528, CM 34853; all ×1.

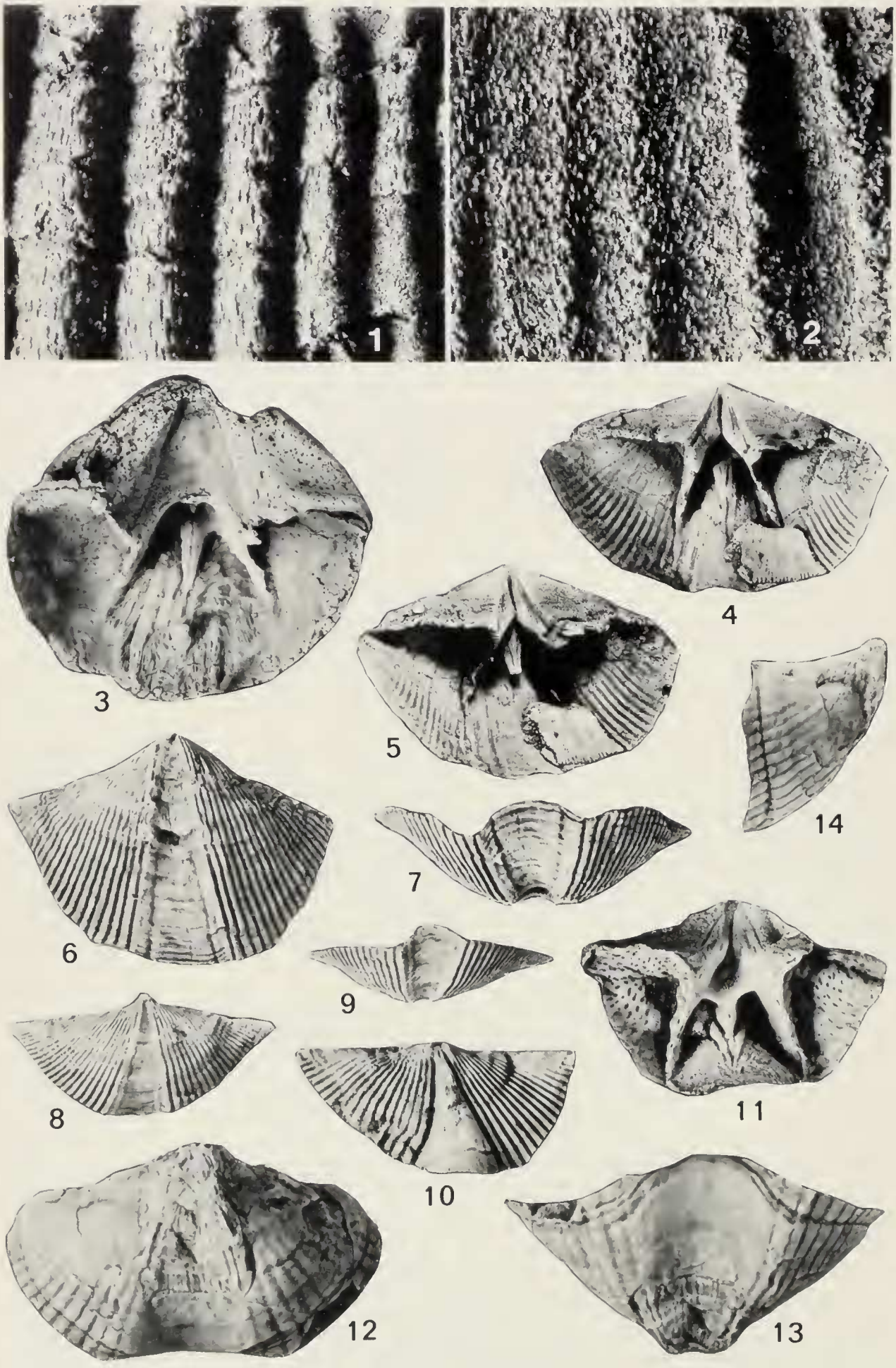
and lacks any indication of mucronation of the cardinal extremities. Figures 9.6 and 9.7 show the moderately diverging dental plates and well-developed subdelthyrial plate. The relatively small number of uniform costae on the fold-sulcus suggest that this species is similar to the specimens illustrated by Greiner (1957: plate 9, fig. 9–13) as "*Spirifer*" *allegheniensis* Caster. The latter species, described from the Corry Sandstone, bears bifurcating costae on the flanks and belongs in the genus *Parallelora* Carter. These Price specimens may well represent an undescribed new species, but the material at hand is too fragmentary and poorly preserved for description.

Suborder Spiriferinidina Ivanova
Superfamily Syringothyridacea Frederiks
Family Syringothyrididae Frederiks
Subfamily Syringothyridinae Frederiks
Genus *Syringothyris* Winchell, 1863

Syringothryis angulata Simpson, 1890
Fig. 10.1, 10.3–10.11

1890. *Syringothyris angulata* Simpson, p. 440, fig. 1–3.
1960. *Syringothyris angulata* Simpson: Sass, p. 350–355, pl. 34, fig. 1–8.

Remarks.—For a complete synonomy the reader is referred to Sass (1960). This is one of the most common species in the late Famennian age faunas at Bowden and Hendricks (SL 528 and 530). The strongly apsacline ventral interarea and slightly mucronate cardinal extremities serve to distinguish this species from that


1
2
3
4
5
6
7
8
9
10
11
12
13
14

of the Mississippian horizon in the Price Formation. Internally, the lack of a septum supporting the syrinx serves to differentiate it from "*Syringothryis*" *randalli* Simpson, 1890, in which the syrinx is partially supported by a strong short septum. Sass (1960) reported 18 to 20 simple ribs on the flanks of *Syringothyris angulata*. These Price specimens have 17 to 22 ribs on each flank but 18 to 20 includes most specimens. One pedicle valve has 19 ribs on one flank and 22 on the other.

The four pedicle valve interiors shown here (Fig. 10.3–10.5, 10.11) show the progressive buildup of thick callus in the ventral umbonal region. In Fig. 10.4, converging callus deposits in the delthyrial chamber obscure the subdelthyrial plate. On the floor of the valve the adductor scars are slightly raised on callus. In Fig. 10.11, the adductor callus on the floor of the valve has become so thick that it touches and fuses with the syrinx. Figure 10.3 shows a very large, thick-shelled partial specimen in which there is little callus apically, showing instead a large, smoothly-rounded, concave subdelthyrial plate. The adductor callus in this specimen has filled the entire apical chamber under the subdelthyrial plate, enclosing the syrinx and leaving only a tiny vestigial remnant. The tiny remaining syrinx is probably much too small to have been functional. This implies that the large, possible gerontic, specimen may have lacked a functional pedicle.

Syringothyris sp.
Fig. 10.12–10.14

Remarks.—A single large syringothyridid pedicle valve was recovered from Clover Lick (SL 525). Most of the shell was spalled from this specimen in collecting. On the flanks there are about 13 or 14 coarse, flattened, simple costae and at least one more pair on the sides of the sulcus. The high concave interarea is nearly catacline, but was probably slightly procline as a juvenile. Within the delthyrial chamber there is a definite syrinx projecting forward from a concave subdelthyrial plate, although the entire length of it could not be readily excavated.

The size, catacline interarea, and paucicostate ornament serve to distinguish this specimen from other early Mississippian previously described taxa. In all likelihood it represents an undescribed species.

Genus *Verkhotomia* Sokolskaya, 1963

Verkhotomia nascens, new species
Fig. 10.2, 11.1–11.12

Holotype.—A partially spalled, nearly compete, medium-sized specimen, CM 34866, Fig. 11.5–11.9, from Clover Lick (SL 525).

←

Fig. 10.—Syringothyridids; 10.1, micro-ornament of a natural limonite cast of the exterior of *Syringothyris angulata* Simpson, 1890, from locality SL 528, CM 34854, ×10; 10.2, micro-ornament of a natural mold of *Verkhotomia nascens* n. sp. from locality SL 525, CM 34855, ×10; 10.3–10.11, *Syringothyris angulata* Simpson, 1890; 10.3, a latex cast of a very large thick pedicle valve interior showing the vestigial syrinx just under the much thickened subdelthyrial plate, CM 34856; 10.4, 10.5, ventral and oblique views of a latex cast of a medium-sized pedicle valve interior, CM 34857; 10.6–10.9, ventral and anterior views of two natural molds of pedicle valve exteriors, CM 34858 and 34859; 10.10, a natural mold of a brachial valve exterior, CM 34860; 10.11, latex cast of the umbonal portion of a large pedicle valve interior with the syrinx fused with callus to the adductor scars, CM 34861; all from locality SL 528; all ×1; 10.12–10.14, *Syringothyris* sp., ventral, anterior, and lateral views of a large spalled pedicle valve from locality SL 525, CM 34862, ×1.

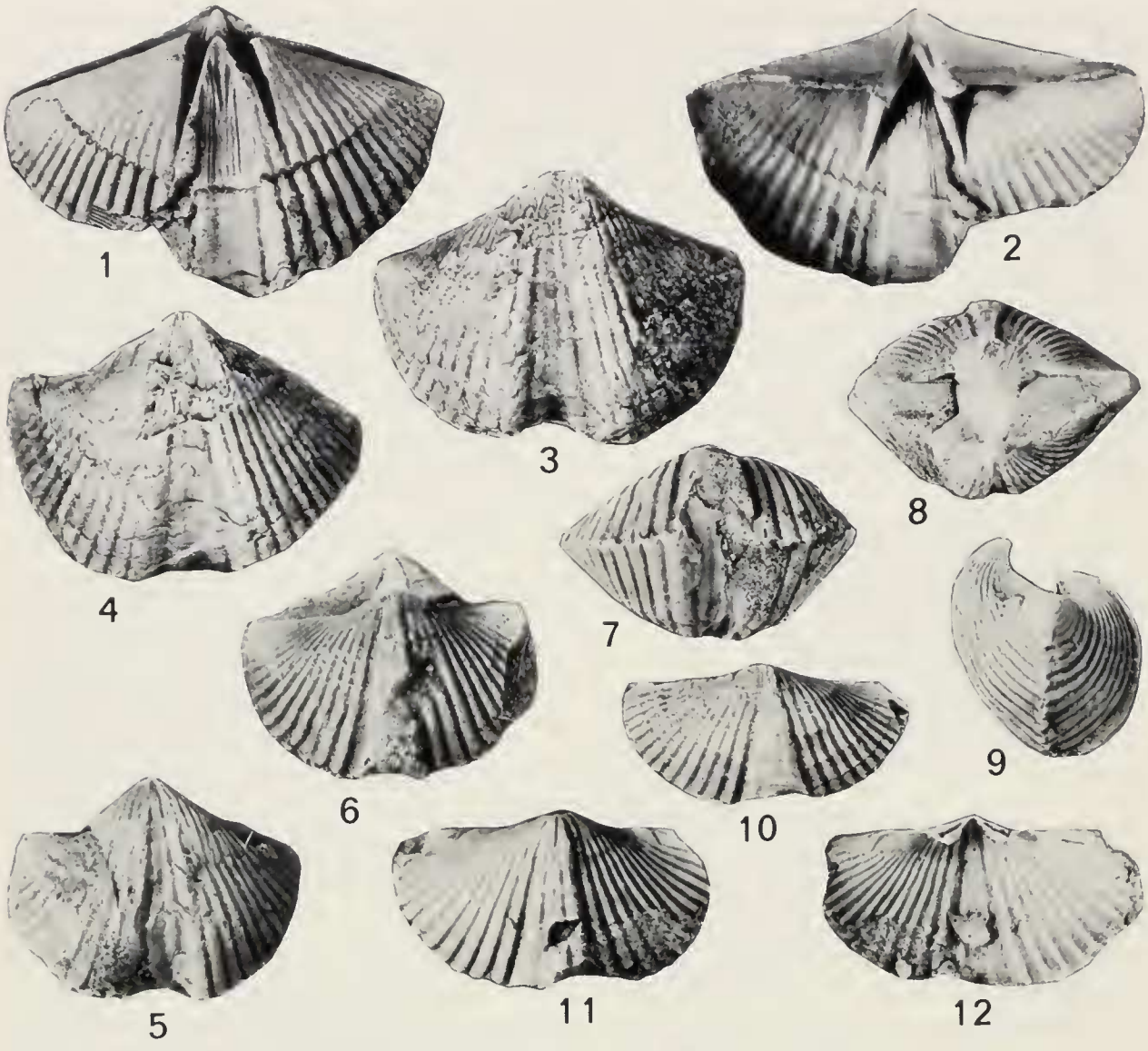


Fig. 11.—*Verkhotomia nascens* n. sp.; 11.1, 11.2, natural mold and latex cast of a large pedicle valve interior showing the strong dental plates and subdelthyrial plate, from locality SL 525, CM 34863; 11.3, 11.4, two spalled medium-sized pedicle valves from locality SL 525, CM 34864 and 34865; 11.5–11.9, ventral, dorsal, anterior, posterior, and lateral views of the slightly spalled nearly complete holotype, CM 34866, from locality SL 525; 11.10, a small spalled brachial valve exterior from locality SL 527, CM 34867; 11.11, 11.12, a natural internal mold and latex cast of a medium-sized brachial valve from locality SL 525, CM 34868; all ×1.

Paratypes.—Two medium-sized pedicle valves, CM 34864 and CM 34865, Fig. 11.9, 11.4, from Clover Lick (SL 525); an internal mold of a large pedicle valve, CM 34863, Fig. 11.1, 11.2, from Clover Lick (SL 525); a spalled medium-sized brachial valve exterior, CM 34867, Fig. 11.10, from Mace (SL 527); an internal mold of a medium-sized brachial valve, CM 34868, Fig. 11.12, from Clover Lick (SL 525).

Description.—Smaller than average for genus, subequally biconvex, transversely subelliptical in outline; lateral extremities subangular or slightly rounded with maximum width attained at or slightly anterior to hingeline; fold and sulcus moderately well developed and defined, anterior commissure uniplicate; ornament consisting of 13 or 14 simple rounded costae separated by narrower rounded furrows on each flank; sulcus with two or three obscure costae and fold with three or four weak costae; strong growth varices irregularly spaced, growth lines not observed; micro-ornament consisting of textile-like surface of papillae and pits arranged in quincunx; shell substance finely punctate.

Table 6.—*Measurements (in mm) of the types of* Verkhotomia nascens, *n. sp.*

CM#	Locality	Valve	Length	Width	Thickness	Ribs/flank
34866	SL 525	Both	27.1	+32.9	22.4	13
34863	SL 525	Pedicle	32.9	50.8	+13.5	14
34864	SL 525	Pedicle	30.9	42.2	10.5	13
34865	SL 525	Pedicle	32.5	40.6	10.8	13
34867	SL 527	Brachial	16.0	32.7	7.1	13
34868	SL 525	Brachial	19.9	+36.2	+8.2	13

Pedicle valve moderately inflated, slightly thicker than opposite valve, most convex in moderately inflated umbonal region; beak small, acute, slightly incurved; flanks moderately convex, sloping gently to lateral margins; lateral extremities very slightly compressed but not forming auriculations; sulcus shallow, rounded, of moderate breadth, originating near beak; interarea moderately to strongly apsacline, moderately high, moderately concave; perideltidial areas and other ornament not observed; delthyrium almost twice as high as wide, delthyrial cover not observed; subdelthyrial plate thickened with callus and filling apical one-third of delthyrial opening; interior with long stout diverging dental adminicula that project anteriorly, more or less following shoulders of sulcus and enclosing ventral muscle field; adductor scars raised on narrow elongate callus at posterior portion of muscle field under subdelthyrial plate; diductor scars longitudinally striated.

Brachial valve moderately inflated, almost evenly convex in lateral profile, most convex in dorsal umbonal region; flanks gently and evenly convex except for slight compression at lateral extremities; fold originating at dorsal beak, well delimited but remaining low and flattened throughout entire length; dorsal interarea low, flat, anacline; interior with concave striate cardinal process supported only by low, short callus and enclosed between fused inner socket ridges and crural bases; sockets widely diverging, bounded by thin subangular inner and outer socket ridges; adductor field contained within sulcus, weakly impressed, divided by weak, very low median ridge; other internal details not observed.

Distinguishing characters.—This species is characterized by having 13 or 14 costae per flank, two or three obscure ribs in the sulcus, an apsacline ventral interarea and anacline dorsal interarea, shallow sulcus, and low flattened fold.

Comparisons.—The only other North American Kinderhookian species of this genus is *Verkhotomia calvini* (Weller, 1914) which was described from the late Kinderhookian Hampton Formation of northcentral Iowa. This much younger species is similar in most aspects to *Verkhotomia nascens* n. sp., but differs in having more numerous and better defined ribs in the sulcus and a well-rounded fold on the brachial valve. In addition, *Verkhotomia calvini* usually has more than 14 costae on the flanks in large specimens, whereas *Verkhotomia nascens* n. sp. usually has only 13 per flank even in large specimens. The several North American Osagean species of this genus are not closely similar to *Verkhotomia nascens* n. sp.

Remarks.—The first few pedicle valves of this species we examined had only two ribs in the sulcus which suggested to us that it belonged in the recently proposed genus *Zeugopleura* Carter, 1988. After many specimens with three sulcal ribs turned up, and in conjunction with the apsacline ventral interarea, it became clear that this Price species belonged in the genus *Verkhotomia* Sokolskaya. Interestingly, the genus *Zeugopleura* does have a representative in the Appalachian Basin in the Riddlesburg Shale of southcentral Pennsylvania. This is the poorly known and very rare *Zeugopleura composita* (Girty, 1928), a small procline species similar to the type species of the genus, *Zeugopleura jeffersonensis* (Weller, 1906).

Distribution.—This new species is the most common faunal element at Clover Lick and Mace (SL 525 and 527). It is moderately common at Durbin (SL 526) and Keysers Ridge, Maryland (SL 532).

ACKNOWLEDGMENTS

Acknowledgment is made to the donors of the Petroleum Research Fund, administered by the American Chemical Society, for support of Kammer (PRF 15605-G2) and to the National Science Foundation for an E.P.S.Co.R. grant to Kammer. Thomas W. Bjerstedt provided invaluable assistance in the field. Alison Hanham drafted the figures.

REFERENCES CITED

ARKLE, T., JR., ET AL. 1979. The Mississippian and Pennsylvanian (Carboniferous) systems in the United States—West Virginia and Maryland. U.S. Geological Survey Professional Paper 1110-D, 35 pp.

BERG, T. M., M. K. MCINERNEY, J. H. WAY, AND D. B. MACLACHLAN. 1983. Stratigraphic correlation chart of Pennsylvania. Pennsylvania Topographic and Geologic Survey, General Geology Report 75.

BERG, T. M., J. H. WAY, AND M. K. MCINERNEY. 1985. Column 21, *in* Northern Appalachian Region (F. A. Lindberg, ed.), Correlation of stratigraphic units of North America (COSUNA), American Association of Petroleum Geologists, Tulsa, Oklahoma.

BJERSTEDT, T. W. 1986. Stratigraphy and deltaic depositional systems of the Price Formation (Upper Devonian-Lower Mississippian) in West Virginia. Unpublished Ph.D. dissertation, West Virginia University, Morgantown, 730 pp.

———. 1987. Trace fossils indicating estuarine deposystems for the Devonian-Mississippian Cloyd Conglomerate Member, Price Formation, Central Appalachians. Palaios, 2:339–349.

BJERSTEDT, T. W., AND T. W. KAMMER. 1987. Comment on "Sedimentary response to Mississippian tectonic activity at the east end of the 38th Parallel fracture zone." Geology, 15:282–283.

———. 1988. Genetic stratigraphy and depositional systems of the Upper Devonian-Lower Mississippian Price-Rockwell deltaic complex in the central Appalachians, U.S.A. Sedimentary Geology, 54:265–301.

BRANSON, E. B. 1938. Stratigraphy and paleontology of the Lower Mississippian of Missouri, part 1. University of Missouri Studies, 13(3):1–205.

BREZINSKI, D. K. 1989. Lower Mississippian foreland basin deposits of western Maryland. Field Trip Guidebook T226, 28th International Geological Congress, American Geophysical Union, Washington, DC, 13 pp.

BUTTS, C. 1940. Geology of the Appalachian valley in Virginia. Virginia Geological Survey, Bulletin 52, Part 1, 568 pp.

CARTER, J. L. 1974. New genera of spiriferid and brachythyridid brachiopods. Journal of Paleontology, 48:674–696.

———. 1988. Early Mississippian brachiopods from the Glen Park Formation of Illinois and Missouri. Bulletin of Carnegie Museum of Natural History, Number 28, 82 pp.

CASTER, K. E. 1930. Higher fossil faunas of the upper Allegheny. Bulletins of American Paleontology, 15(58):174 pp.

———. 1934. The stratigraphy and paleontology of northwestern Pennsylvania, part 1: stratigraphy. Bulletins of American Paleontology, 21(71):185 pp.

CONRAD, T. A. 1842. Observations on the Silurian and Devonian systems of the United States, with descriptions of new organic remains. Academy of Natural Sciences of Philadelphia, Journal, 8: 228–280.

COOPER, G. A., AND J. T. DUTRO, JR. 1982. Devonian brachiopods of New Mexico. Bulletins of American Paleontology, 82–83(315):215 pp.

COOPER, G. A., AND R. E. GRANT. 1972–1977. Permian brachiopods from west Texas (parts 1–6). Smithsonian Contributions to Paleobiology, Nos. 14, 15, 19, 21, 24, 32:3370 pp.

DALLY, J. E. 1956. Stratigraphy and paleontology of the Pocono Formation in West Virginia. Unpublished Ph.D. dissertation, Columbia University, New York, 241 pp.

DARTON, N. H. 1894. Description of the Staunton sheet, West Virginia, Virginia. U.S. Geological Survey Geologic Atlas, Folio 14, 4 pp.

DENNISON, J. M. 1970. Stratigraphic division of the Greenland Gap Group ("Chemung Formation") along Allegheny Front in West Virginia, Maryland, and Highland County, Virginia. Southeastern Geology, 12:53–82.

ENGLUND, K. J., S. E. BROWN, AND J. T. DUTRO, JR. 1988. Pocono Dome, West Virginia—Catskill Island or Fantasy Island? American Association of Petroleum Geologists Bulletin, 72:961.

FLOWER, R. H., AND K. E. CASTER. 1935. The stratigraphy and paleontology of northwestern Pennsylvania, part II: paleontology, section A: the cephalopod fauna of the Connewango Series of the

Upper Devonian in New York and Pennsylvania. Bulletins of American Paleontology, 22(75): 199–271.
FOERSTE, A. F. 1909. The Bedford fauna at Indian Fields and Irvine, Kentucky. The Ohio Naturalist, 9(7):515–523.
GIRTY, G. H. 1928. The Pocono fauna of the Broad Top Coal Field, Pennsylvania. U.S. Geological Survey, Professional Paper 150-E:111-127.
GOSSELET, J. 1888. L'Ardenne. Ministère des Travaux Publics, Memoire, Paris, 889 pp.
GREINER, H. 1957. "*Spirifer disjunctus*": its evolution and paleoecology in the Catskill Delta. Peabody Museum of Natural History, Bulletin 11, 75 pp.
HYDE, J. 1953. Mississippian formations of central and southern Ohio. Ohio Division of Geological Survey, Bulletin 51, 355 pp.
KAMMER, T. W., AND T. W. BJERSTEDT. 1986. Stratigraphic framework of the Price Formation (Upper Devonian-Lower Mississippian) in West Virginia. Southeastern Geology, 27:13–33.
LAIRD, W. M. 1941. The Upper Devonian and Lower Mississippian of southwestern Pennsylvania. Pennsylvania Topographic and Geologic Survey, Progress Report 126, 23 pp.
———. 1942. The stratigraphy of the Upper Devonian and Lower Mississippian of southwestern Pennsylvania. Unpublished Ph.D. dissertation, University of Cincinnati, Cincinnati, Ohio, 244 pp.
MCKELLAR, R. G. 1970. The Devonian productoid brachiopod faunas of Queensland. Geological Survey of Queensland, Publication 342, Palaeontological Papers, 18:40 pp.
ROBERTS, J. 1971. Devonian and Carboniferous brachiopods from the Bonaparte Gulf Basin, northwestern Australia. Bureau of Mineral Resources, Geology and Geophysics, Bulletin 122, 317 pp.
RODRIGUEZ, J., AND R. C. GUTSCHICK. 1967. Brachiopods from the Sappington Formation (Devonian-Mississippian) of western Montana. Journal of Paleontology, 41:364–384.
SARTENAER, P. 1970. Nouveaux genres rhynchonellides (brachiopodes) du paléozoique. Institut Royal des Sciences Naturelles de Belgique, Bulletin, 46(32):1–32.
SASS, D. B. 1960. Some aspects of the paleontology, stratigraphy, and sedimentation of the Corry Sandstone of northwestern Pennsylvania. Bulletins of American Paleontology, 41(192):247–381.
SIMPSON, G. B. 1890. Descriptions of new species of fossils from the Clinton, Lower Helderberg, Chemung, and Waverly groups, found in the collections of the Geological Survey of Pennsylvania. American Philosophical Society, Transactions, new series, 16:435–460.
STOSE, G. W., AND C. K. SWARTZ. 1912. Description of the Pawpaw-Hancock quadrangles. U.S. Geological Survey Geologic Atlas, Folio 179, 24 pp.
WELLER, J. M., J. S. WILLIAMS, W. A. BELL, C. O. DUNBAR, L. R. LAUDON, R. C. MOORE, P. B. STOCKDALE, P. S. WARREN, K. E. CASTER, C. L. COOPER, B. WILLARD, C. CRONEIS, C. A. MALOTT, P. H. PRICE, AND A. H. SUTTON. 1948. Correlation of the Mississippian formations of North America. Bulletin of the Geological Society of America, 59:91–196.
WELLER, S. 1906. Kinderhook faunal studies. 4. The fauna of the Glen Park limestone. Academy of Science of St. Louis, Transactions, 16:435–471.
———. 1914. The Mississippian Brachiopoda of the Mississippi Valley Basin. Illinois Geological Survey, Monograph 1, 508 pp.
WHITE, D. 1934. The age of the Pocono. American Journal of Science, 27:265–272.
WILLIAMS, H. S. 1887. On the fossil faunas of the Upper Devonian, the Genessee Section, New York. U.S. Geological Survey, Bulletin, 41:123 pp.
WILLIAMS, J. S. 1943. Stratigraphy and fauna of the Louisiana Limestone of Missouri. U.S. Geological Survey Professional Paper 203, 133 pp.

APPENDIX

Price Formation Brachiopod Localities and Stratigraphic Notes, Arranged from North to South

1. SL 522, SUMMIT, Fayette Co., PA, Brownfield Quad. Oswayo Formation: Lat. 39°51′39″, Long. 79°40′06″; Cussewago Sandstone: Lat. 39°51′47″, Long. 79°40′40″. Two fossiliferous horizons on the north side of U.S. Route 40 on Chestnut Ridge east of Uniontown; see Laird (1941:13; 1942:43–47, 74). Note that the stratigraphically higher Cussewago Sandstone crops out down the hill from the Oswayo Formation (the rocks have a greater dip than the road). The Oswayo outcrop is 1.8 km west of the summit of Chestnut Ridge and 3.1 km east of Hopwood. The Cussewago outcrop is 2.6 km west of the summit of Chestnut Ridge, 2.3 km east of Hopwood, and directly across from the entrance to the Pennsylvania State Forest Lick Hollow Picnic Area. Laird (1941, 1942) reported the Famennian nautiloid *Neocycloceras obliquum* Flower and Caster from this outcrop; no specimens of this species were found during the present study.

Laird's (1941) Shale C and Sandstone D are equivalent to the Oswayo Formation, and his Conglomerate F and Sandstone G are equivalent to the Cussewago Sandstone. The Riddlesburg Shale has been removed by erosion so that the basal conglomerate of the Rockwell Formation (Conglomerate I of Laird, 1941) overlies the Cussewago Sandstone.

2. SL 532, KEYSERS RIDGE, Garrett Co., MD, Accident Quad. Lat. 39°41′40″, Long. 79°15′42″. Basal sandstone of the Riddlesburg Shale Member of the Price Formation cropping out on the north side of U.S. Route 48, 1.0 km west of the interchange with U.S. Route 219 South. The Rockwell Member is well exposed at the interchange and contains plant fossils. Brezinski (1989, fig. 8) provides a columnar section for this locality.

3. ROWLESBURG, Preston Co., WV, Rowlesburg Quad. Outcrop along railroad tracks northwest of Rowlesburg on the west side of the Cheat River. Base of section: Lat. 39°21′31″, Long. 79°41′41″. A complete section of the Price Formation present; columnar sections presented in Bjerstedt (1986: 576–592), Kammer and Bjerstedt (1986, fig. 4), and Bjerstedt and Kammer (1988, fig. 5). There are two different late Famennian faunas (Fig. 1, Table 1). The oldest late Famennian fauna is from the lower part of the Oswayo Member (Unit 8 in Bjerstedt, 1986). The latest Famennian fauna is from the uppermost Oswayo (Unit 26) and the Cussewago Sandstone Member (Unit 30).

4. SL 530, HENDRICKS, Tucker Co., WV, Mozark Mountain Quad. Lat. 39°05′00″, Long. 79°37′06″. Late Famennian brachiopods (Fig. 1, Table 1) were found in float from a sandstone below the Riddlesburg Shale Member, probably from the Cussewago Sandstone Member. Float was found in the gully of a small stream tributary to the Blackwater River, along abandoned railroad tracks on the north side of the river, 1.2 km northeast of Hendricks. Nearby outcrops of the Riddlesburg Shale Member consist of dark gray, platy shale with abundant orbiculoid brachiopods.

5. SL 528, BOWDEN, Randolph Co., WV, Bowden Quad. New roadcut on WV Route 33, Lat. 38°54′24″, Long. 79°43′05″. Outcrop on old Route 33, Lat. 38°54′43″, Long. 79°42′32″ (Dally, 1956: 191–192). Two outcrops within 1 km of each other. The Price Formation is only 6 m thick at both localities. The late Famennian age of the brachiopods and *Neocycloceras obliquum* Flower and Caster suggests that the sandstones are part of the Cussewago Sandstone Member and not a basal Riddlesburg sandstone (Bjerstedt and Kammer, 1988, fig. 5D). See Bjerstedt (1986:604–608) and Bjerstedt and Kammer (1987, fig. 2) for a columnar section. Specimens of *Cyrtospirifer* sp. B and *N. obliquum* were collected at the old Route 33 outcrop (Unit 8 of Dally, 1956).

6. WAMSLEY RUN, Pendleton Co., WV, Laneville Quad. Lat. 38°53′11″, Long. 79°28′11″. Late Famennian fauna (Table 1) found in top of Cussewago Sandstone Member directly below Riddlesburg Shale Member cropping out on Route 33 (Unit 7, Bjerstedt, 1986:598–603). Bjerstedt and Kammer (1988, fig. 5F) incorrectly considered the sandstone to be a basal sandstone of the Riddlesburg Shale Member. The Cussewago sits directly on the red beds of the Hampshire Formation.

7. SL 526, DURBIN, Pocahontas Co., WV, Durbin Quad. Lat. 38°33′00″, Long. 79°50′48″. Outcrop is 1.3 km west of the West Fork of the Greenbrier River at Durbin along Back Mountain Road. See Dally (1956:180–181) for a measured section. There are approximately 6 m of the Cloyd Conglomerate Member, 30 m of the Riddlesburg Shale Member, and 18 m of the Rockwell Member. Kinderhookian fossils occur approximately 9 m above the base of the Riddlesburg (Unit 5 of Dally, 1956).

8. SL 527, MACE, Randolph Co., WV, Mingo Quad. Lat. 38°28′25″, Long. 80°02′03″. Kinderhookian fossils in basal sandstones of the Riddlesburg Shale Member on the west side of U.S. Route 219 (Bjerstedt, 1986:612–618, Unit 13; Bjerstedt and Kammer, 1988, fig. 6D).

9. SL 525, CLOVER LICK, Pocahontas Co., WV, Clover Lick Quad. Lat. 38°20′00″, Long. 79°59″40″. Outcrop is at bend of an unnamed dirt road 0.1 km east of Scale Hollow, 0.1 km north of Clover Creek, and 2.2 km west of Clover Lick. Limited exposure of sandstone thought to be basal sandstone of the Riddlesburg Shale Member based on exposure of Riddlesburg Shale along road 1 km south of outcrop. Kinderhookian fauna identical to that at Mace (Table 1).

10. SL 529, MARLINTON, Pocahontas Co., WV, Marlinton Quad. Lat. 38°13′00″, Long. 80°06′10″. Kinderhookian fauna from the upper part of the Riddlesburg Shale Member in Unit 11 of Bjerstedt (1986:622). See Bjerstedt (1986:619–627) and Bjerstedt and Kammer (1988, fig. 6A) for columnar section. Outcrop on west side of Route 219, 1.0 km south of Marlinton.

11. SL 529, SPICE RUN, Pocahontas Co., WV, Denmar Quad. Lat. 38°03′00″, Long. 80°14′30″. A very poorly exposed section along a private road to the abandoned town of Spice Run. Kinderhookian fossils (Table 1) studied are from Dally's (1956:161–164) collections of his Units 14 and 16. Based on Dally's measured section these fossils are interpreted to be from the upper part of the Price above the Riddlesburg Shale Member. Fossiliferous horizons could not be relocated.

12. SL 523, CALDWELL, Greenbrier Co., WV, Lewisburg Quad. Lat. 37°46′30″, Long. 80°22′52″. Outcrops along both sides of Interstate 64 provide a complete exposure of the Price Formation. For a measured section see Bjerstedt (1986:635–675), Kammer and Bjerstedt (1986, fig. 6), and Bjerstedt

and Kammer (1988, fig. 6B). Abundant lag deposits of the Kinderhookian brachiopod *Subglobosochonetes acutiliratus* (Girty, 1928) occur in the upper part of the Price Formation (Units 67 and 70, Bjerstedt, 1986). At this same outcrop are two late Famennian marine horizons near the top of the Cloyd Conglomerate Member (Units 8 and 10, Bjerstedt, 1987, fig. 3). Orbiculoid brachiopods and a poorly preserved rhynchonellid were observed at the I-64 exposure and Dally collected specimens of *Cyrtospirifer* sp. somewhere near this level 0.1 km west along U.S. Route 60 (identified as *Spirifer platynotus* Weller from his Unit 23).